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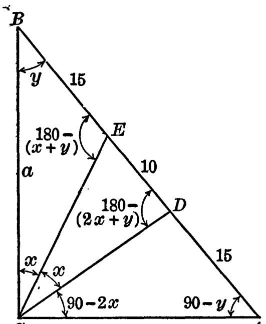
Solution by Marcia Latham, New York City.

Let $BC = a$, $AC = b$, $DC = c$, $\angle DCE = \angle ECB = x$, $\angle ABC = y$. Then $\angle DCA = 90 - 2x$, $\angle EDC = 180 - (2x + y)$, and $\angle BEC = 180 - (x + y)$.



$$\sin y = b/40 \quad \text{and} \quad \cos y = a/40. \tag{1}$$

Since EC bisects $\angle BCD$,

$$a/c = 15/10 = 3/2. \tag{2}$$

In the triangle, DCA, by the law of sines,

$$c/15 = \cos y/\cos 2x. \tag{3}$$

Combining (1), (2), and (3), $2a/45 = a/40 \cos 2x$, or $\cos 2x = 9/16$, $x = 1/2 \cos^{-1} 9/16 = 27° 53' 8''$. In the triangle, BCD, by law of sines, $\sin (2x + y)/\sin y = a/c$. Whence, by (1) and (2)

$$\sin (2x + y) = 3b/80. \tag{4}$$

Also, $a/25 = \sin (2x + y)/\sin 2x$; whence, by (4), $\sin 2x = 15b/16a$. But $\sin^2 2x + \cos^2 2x = 1$. Then $(15b/16a)^2 + (9/16)^2 = 1$; whence

$$b^2 = 7a^2/9. \tag{5}$$

Now, in the triangle, ABC, $a^2 + b^2 = (40)^2$; whence, by (5), $a^2 + 7a^2/9 = 1{,}600$; whence, $a = 30$ and from (5), $b = 10\sqrt{7}$.

Also solved by A. M. Harding, Polycarp Hansen, C. E. Horne, R. A. Johnson, Elmer Latshaw, E. W. Martin, Louis Ordanksy, A. Pelletier, J. L. Riley, H. M. Roeser, L. Smith, D. L. Stamy, H. Tsai, and L. G. Weld.

2760 [1919, 124]. Proposed by Charles N. Schmall, New York City.

In an arithmetical progression, if s_n be the sum of the first n terms, s_{2n} the sum of the first $2n$ terms, and s_{3n} the sum of the first $3n$ terms of the same series, prove that $s_{2n} - s_n = \frac{1}{3}s_{3n}$.

Solution by Emma M. Gibson, Springfield (Mo.) High School.

The sum of n terms of an arithmetical progression is expressed by the formula

$$s_n = \frac{n(a_1 + a_n)}{2},$$

where a_1 and a_n are the first and nth terms, respectively.

Hence, $s_n = n(a_1 + a_n)/2$, $s_{2n} = 2n(a_1 + a_{2n})/2$, and $s_{3n} = 3n(a_1 + a_{3n})/2$ are the sums of the first n terms, the first $2n$ terms, and the first $3n$ terms, respectively. Now $a_{2n} = a_n + nd$, $a_{3n} = a_{2n} + nd = a_n + 2nd$, d being the common difference.

Then $s_{2n} = 2n(a_1 + a_n + nd)/2$ and $s_{3n} = 3n(a_1 + a_n + 2nd)/2$ and

$$s_{2n} - s_n = 2n(a_1 + a_n + nd)/2 - n(a_1 + a_n)/2 = n(a_1 + a_n + 2nd)/2 = s_{3n}/3.$$

Also solved by R. D. Bohannan, H. L. Bridges, Jr., H. N. Carleton, W. F. Cheney, Jr., P. J. da Cunha, H. C. Gossard, William Herberg, C. N. Mills, Louis O'Shaughnessey, H. L. Olson, A. Pelletier, J. B. Reynolds, I. S. Sun, and Elijah Swift.

2768 [1919, 171]. Proposed by Paul Capron, U. S. Naval Academy.

Given the center, a focus, and a point of a conic, construct geometrically the circle of curvature at the point.